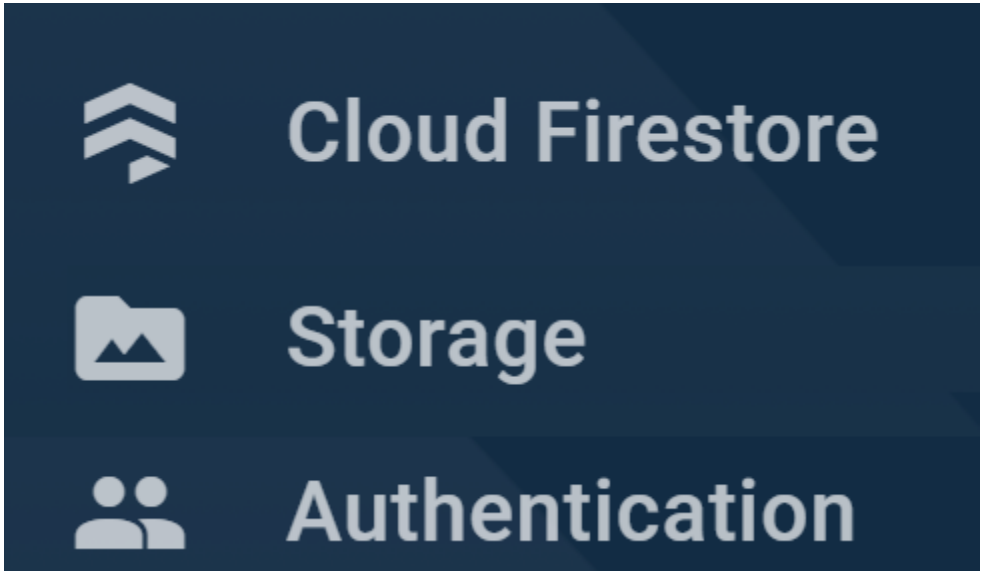
CMPS 312

Firebase Cloud Services



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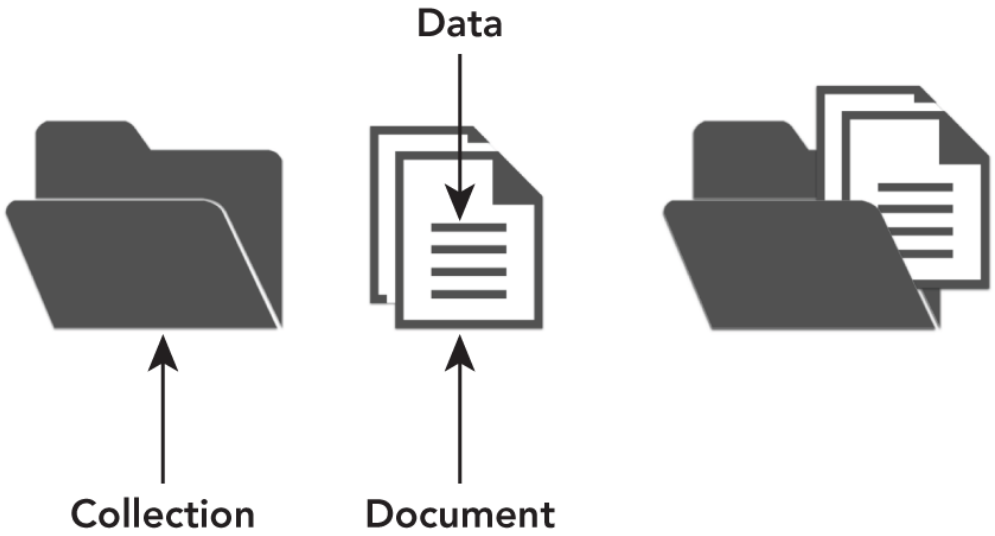
Outline

1. Firestore Data Model
2. Firestore CRUD Operations
3. Firebase Cloud Storage
4. Firebase Authentication

Firebase Cloud Services

- Firebase is a **cloud platform** offering many **services** that work together as a backend server infrastructure for mobile/web apps
- We will focus on introducing:
  -  **Cloud Firestore**: store/query documents in collections
  -  **Cloud Storage**: store and retrieve files
  -  **Firebase Authentication**: secure user's authentication using various identity provides (e.g., email/password, Google Auth)

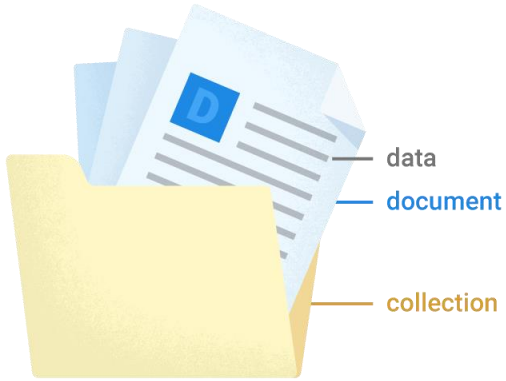
Firestore Data Model



Firestore Database

- Cloud-hosted **scalable** database to manage app data
  - No need to set up or maintain backend servers
- Provides real-time updates and offline support
- Uses a **document-oriented** data model
  - You have a **collections**, which contain documents, which can contain sub-collections to build hierarchical data structures
- **NoSQL** (does not use SQL as a query language)
- Access controlled with **security rules**
- Includes a free tier (1 GiB data, 50K reads/day and 20K writes/day) then pay as you use

Data Model

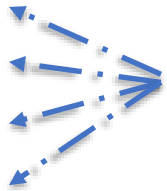


- Firestore is **Document Oriented Database**
  - Uses a **document** data model: Stores data similar to JSON documents (instead of rows and columns as done in a relational database)
  - Arrange documents in **collections** (documents can vary in structure)
  - **API to query** and manage documents

- Better alternative data management solution for Mobile/Web applications compared to using a Relational Database

Document

```
{
  "isbn" : "123",
  "title": "Mr Bean and the Forty Thieves",
  "category": "Fun",
  "pages": 250
  "authors": ["Mr Bean", "Juha Dahak"],
  "publisher": {
              "name": "MrBeanCo",
              "country": "UK“
               }
}
```



property : value

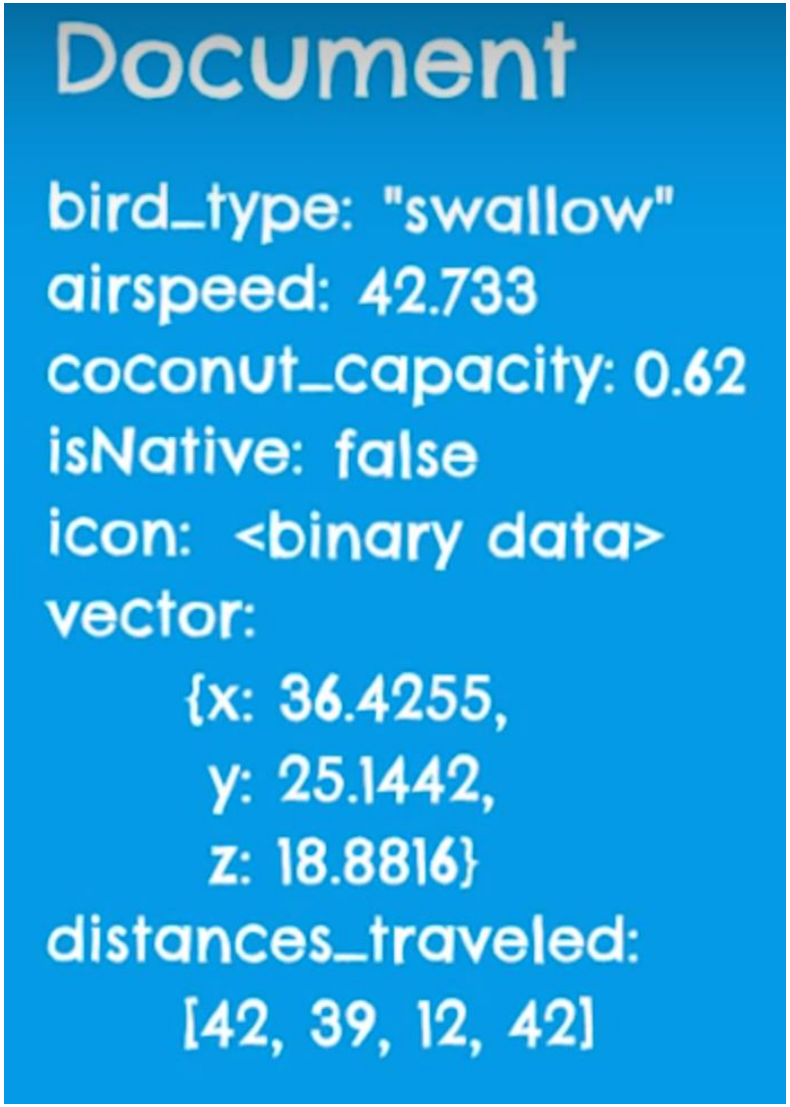
property : array

property : map

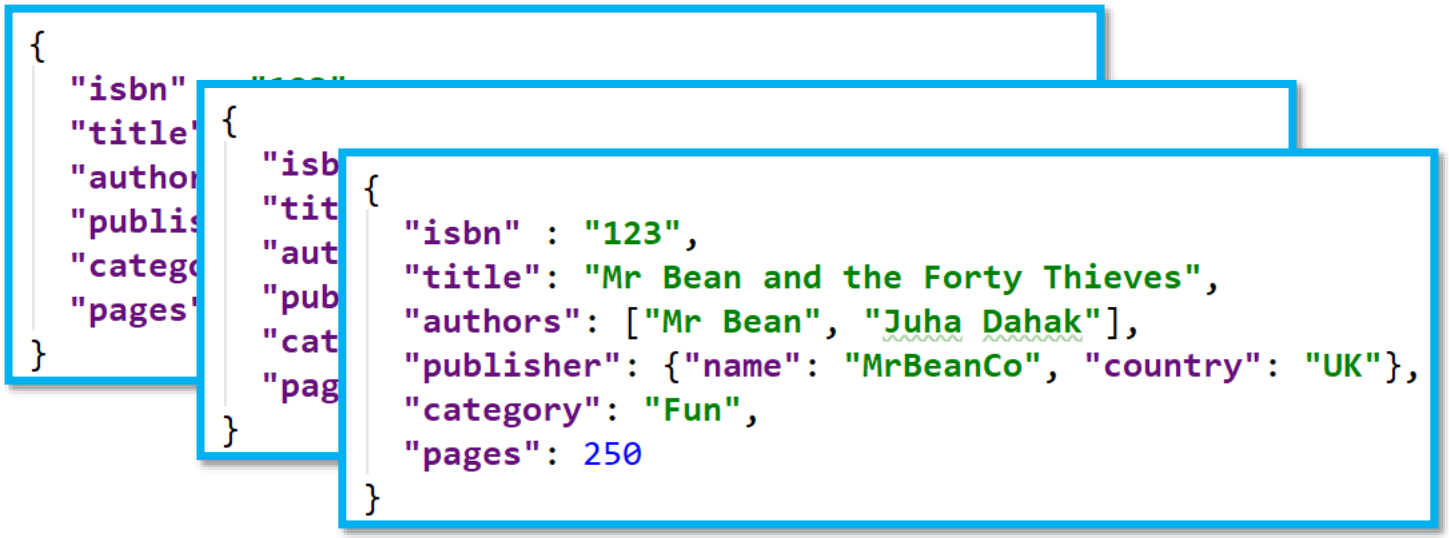
- **Document = JSON**-like object
- **Document = set of key-value pairs**
- **Document = basic unit of data** in Firestore
  - You can only fetch a document not part of it
- Analogous to **row** in a relational database
- Size limit to **1 MB** per document
- A document can optionally point to subcollections
- A Document **cannot** point to another document

Data Types

- Cloud Firestore supports a variety of data types for values:
  - boolean, number, string,
  - geo point, binary blob, and timestamp
  - arrays, nested objects (called maps) to structure a complex object (e.g., address) within a document

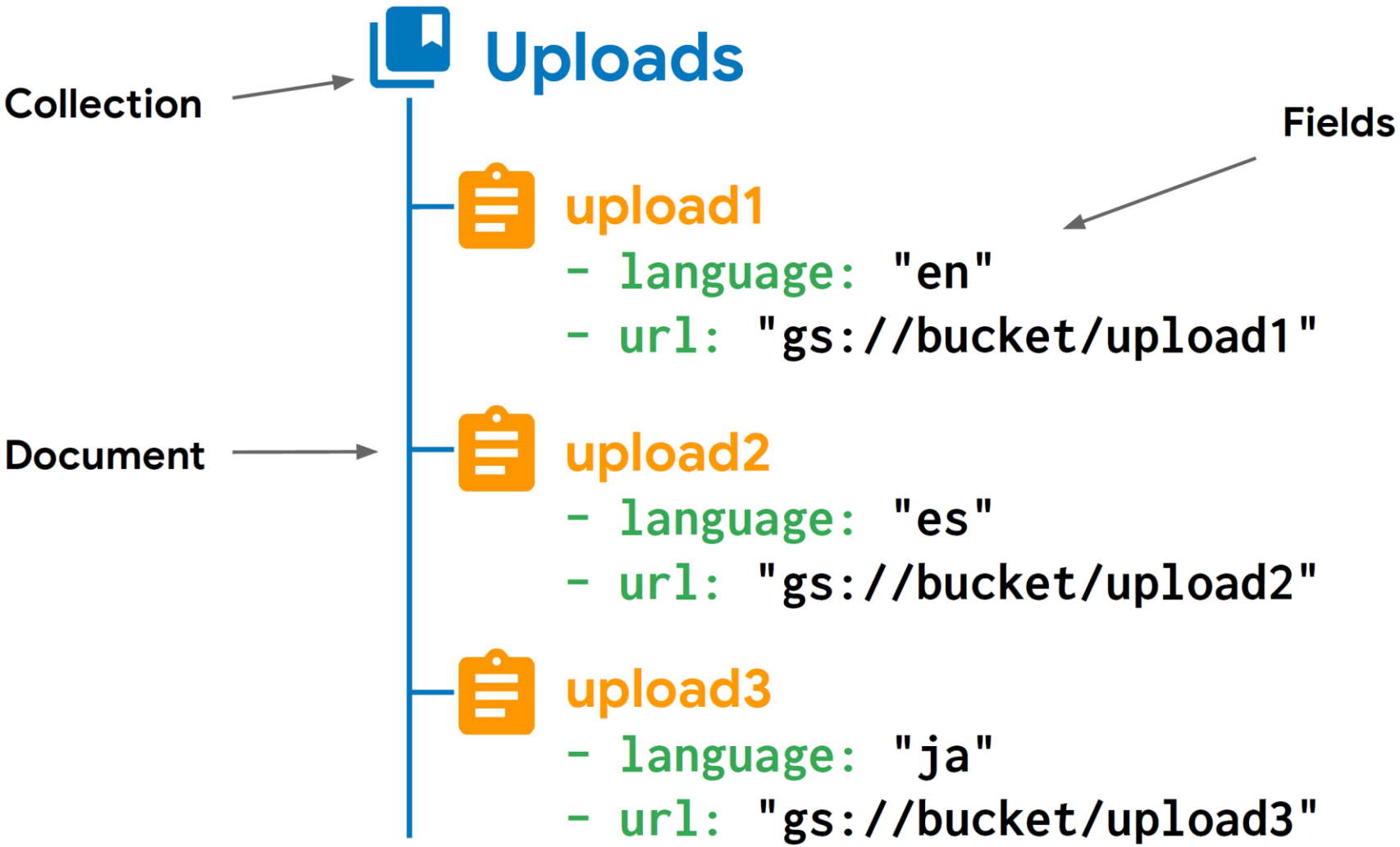


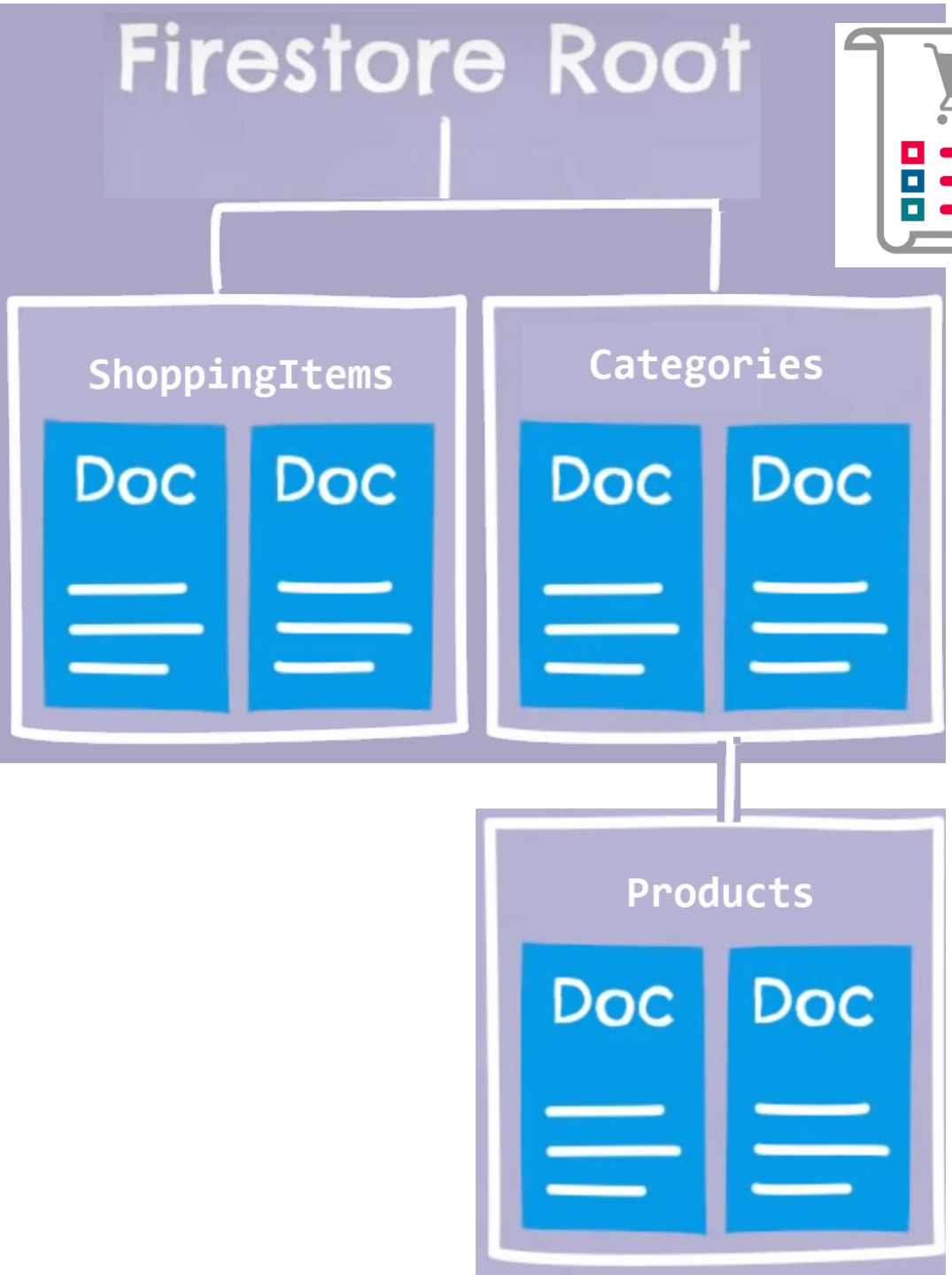
Collection



- **Collection = container** for documents
- Analogous to **table** in a relational database
- **Does not enforce** a schema
- Documents in a collection usually **have similar purpose** but they may have slightly different schema
- Cannot contain other collections

Example Collection & Documents





Shopping List App

- Database with 2 **top-level** collections: `ShoppingItems` and `Categories`
- Each category document has a `Products` sub-collection

Document Identifiers

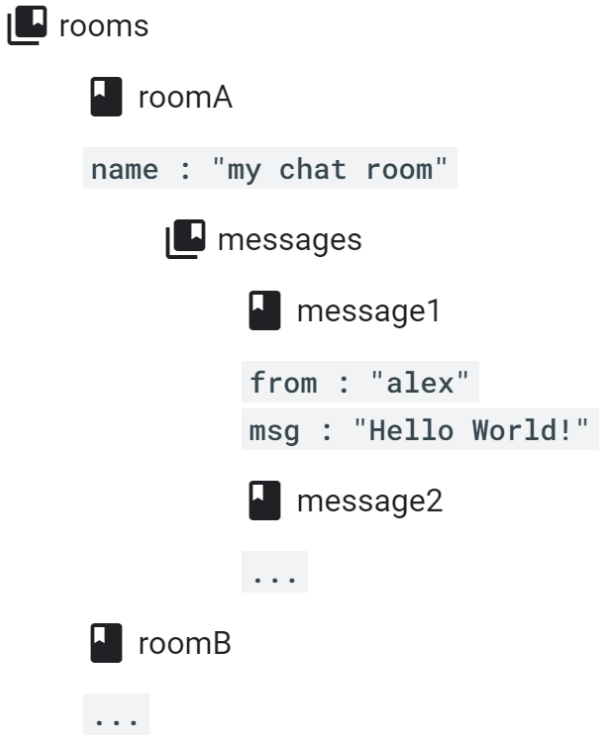
- Documents within a collection have **unique identifiers**
  - You can provide your own keys, such as user IDs, or
  - You can let Cloud Firestore assign a random IDs
- You do not need to "create" or "delete" collections
  - A collection creates creating after you create the first document in a collection
  - A collection is deleted when you delete all the documents in a collection
- Access a document using its **collection** and its doc **Id**
  - `Firebase.firestore.collection(path) => CollectionReference`
  - `Firebase.firestore.document(path) => DocumentReference`

```
val u1DocRef = Firebase.firestore.collection("users").document("u1@test.com")
```

OR using doc path `val u1DocRef = Firebase.firestore.document("users/u1@test.com")`

Subcollections

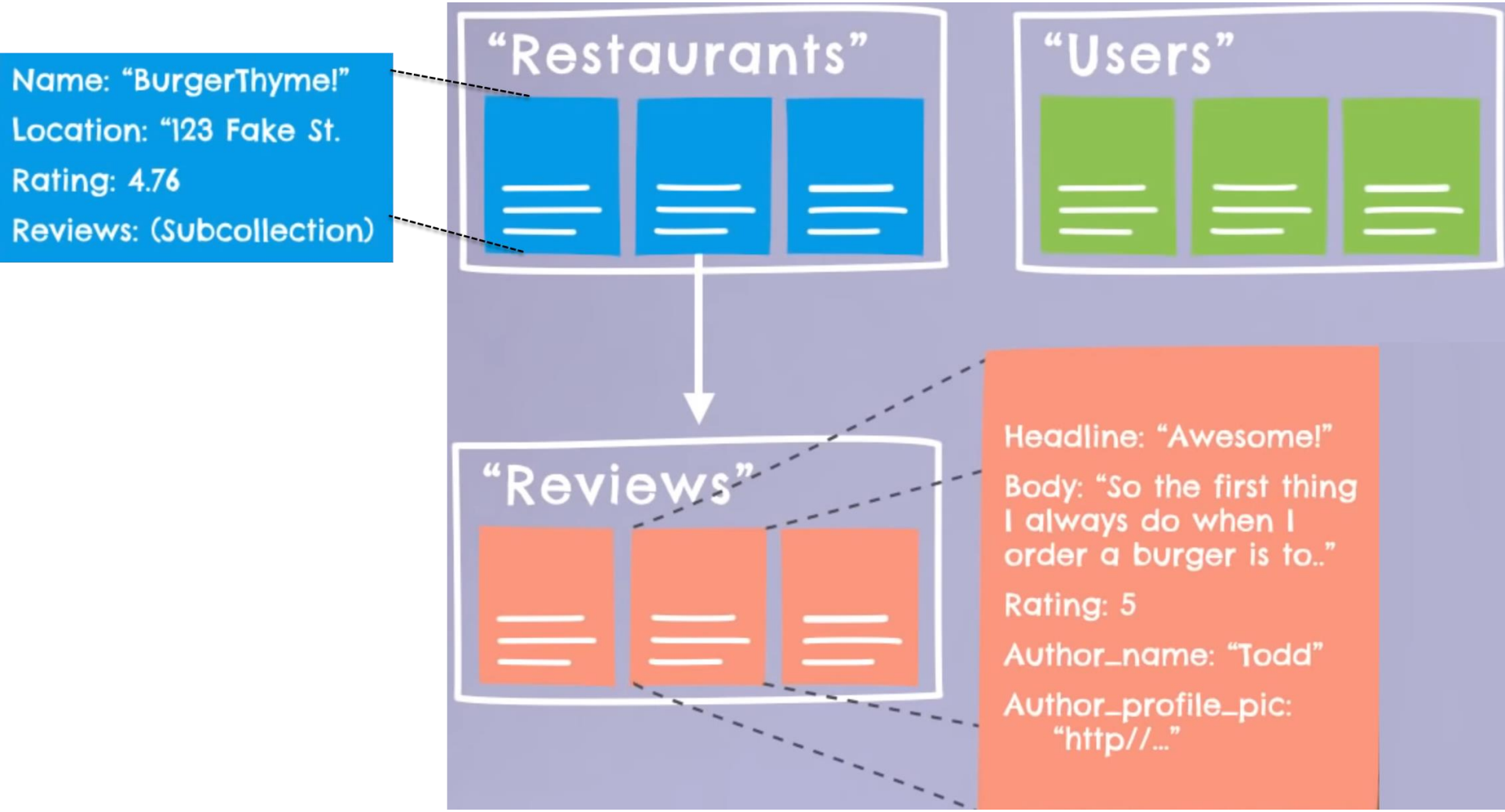
- A subcollection is a collection associated with a specific document
  - E.g., A subcollection called messages for every room document in the rooms collection



- Get a reference to a message in the subcollection

```
val message1DocRef = Firebase.firestore
     .collection("rooms").document("roomA")
     .collection("messages").document("message1")
```

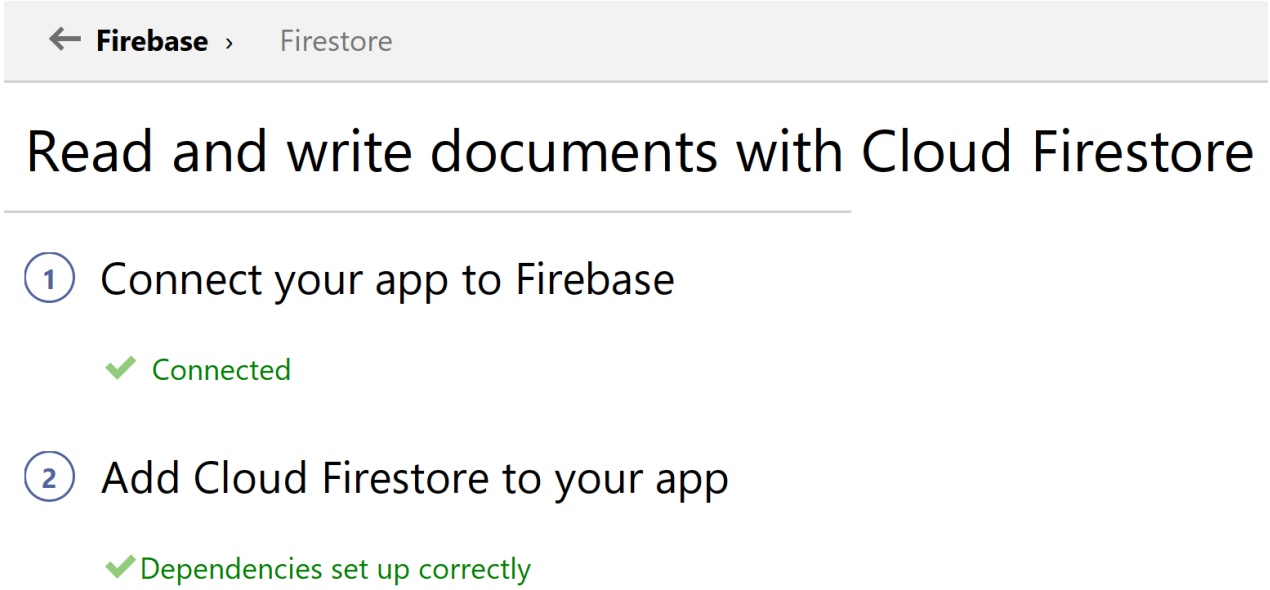
Example Restaurant Review App



Source: https://www.youtube.com/watch?v=v_hR4K4auoQ

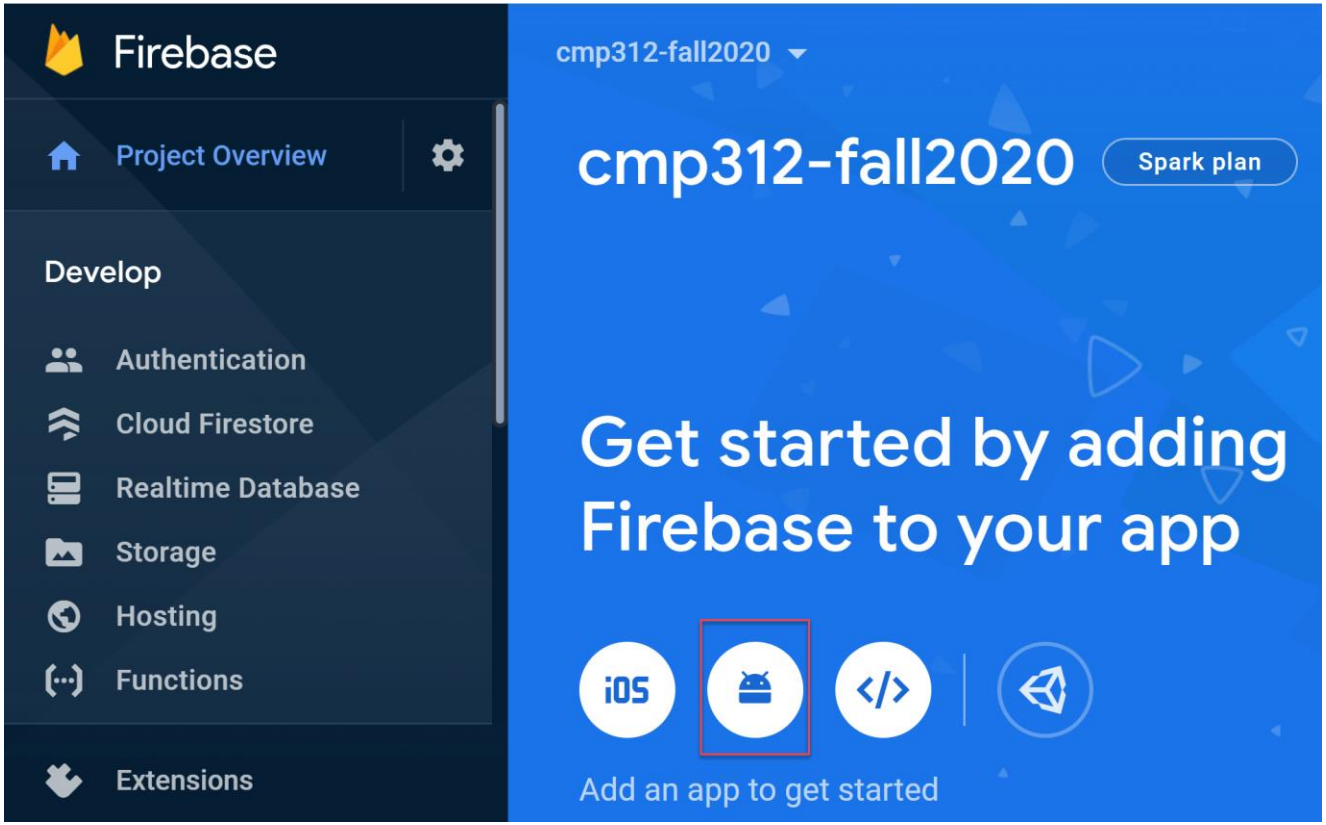
Add Firebase to your Android project

- Login to https://console.firebase.google.com/
- Create a **project** (give it a meaningful name)
  - to keep it simple disable Google Analytics for the project
- From Android Studio use Tools -> Firebase. Then select FireStore and



Alternative setup using Firebase console

- Select **Project Overview** and add an Android app



- Download `google-services.json` and place it under **`/app`** subfolder

Dependencies

- Project-level **build.gradle** (<project>/build.gradle):

```
dependencies {  ....
   // Google services
   classpath 'com.google.gms:google-services:4.3.4'
}
```

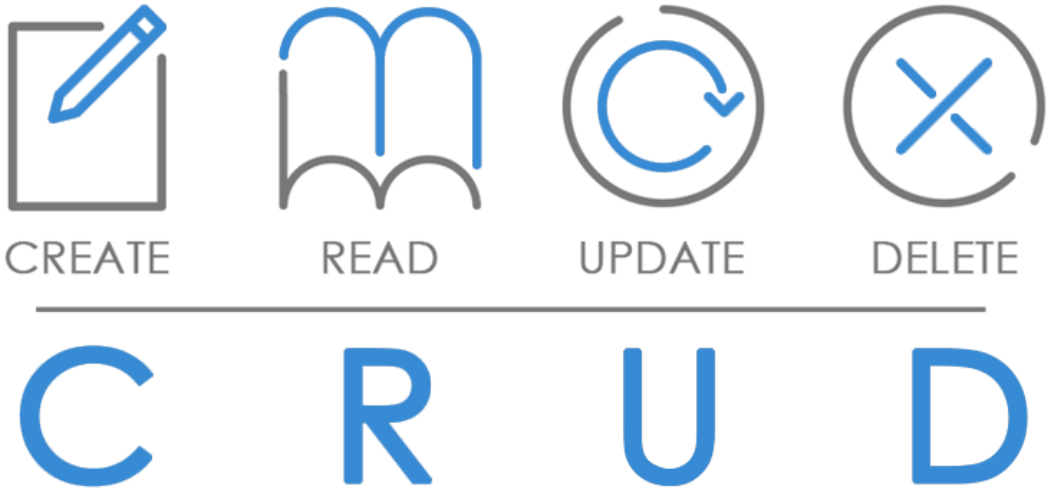
- App-level **build.gradle** (<project>/<app-module>/build.gradle):

```
plugins { …
    id 'com.google.gms.google-services'
}
```

```
dependencies { ...
    // Declare the dependency for the Cloud Firestore library
    // When using the BoM, you don't specify versions in Firebase library dependencies
    implementation 'com.google.firebase:firebase-firestore-ktx'
    implementation 'com.google.firebase:firebase-auth-ktx'
    implementation 'org.jetbrains.kotlinx:kotlinx-coroutines-play-services:1.2.1'

    // FirebaseUI (for authentication)
    implementation 'com.firebaseui:firebase-ui-auth:6.4.0'
    implementation 'com.google.android.gms:play-services-auth:18.1.0'
}
```

Firestore CRUD Operations



Create Data Classes Mapped to Firestore Docs

- Normal **data classes** having the same structure as Firebase docs
- Must have a **no-argument constructor** used by Firebase deserializer
- Doc identifier can be annotated with **@DocumentId**, Firebase will auto-populate it with the doc id
- Can prevent a particular class attribute to Firestore using **@get:Exclude**

```
@get:Exclude val password: String
```

```
data class Category(
    @DocumentId
    val id: String = "", val name: String) {
    // Required by Firebase deserializer other you get exception 'does not define a no-argument constructor'
    constructor(): this("", "")
}
```

Query – return all documents

- Using collection reference use the **.get** method to return the collection documents
  - You can sort the results using **.orderBy**
  - Use **.toObjects** to return the query results as a list of objects
  - Use the same technique to get documents from a subcollection associated with a particular document

```
val categoryCollectionRef = Firebase.firestore.collection("categories")
suspend fun getCategories() : List<Category?> {
    val queryResult = categoryCollectionRef.orderBy("name").get().await()
    return queryResult.toObjects(Category::class.java)
}
suspend fun getProducts(categoryId: String) : List<Product?> {
    val queryResult = categoryCollectionRef.document(categoryId).collection("products")
                                           .orderBy("name", Query.Direction.DESCENDING)
                                           .get().await()
    return queryResult.toObjects(Product::class.java)
}
```

Query – filer using .where

- Use **`.where*`** to filter the documents to return from a collection
- Other filter methods 🔗 are available such as
  - whereNotEqualTo
  - whereGreaterThanOrEqualTo
  - whereIn

```
val citiesRef = db.collection("cities")
citiesRef.whereIn("country", listOf("USA", "Japan"))
```

  - whereArrayContainsAny

```
citiesRef.whereArrayContainsAny("regions", listOf("west coast", "east coast"))
```

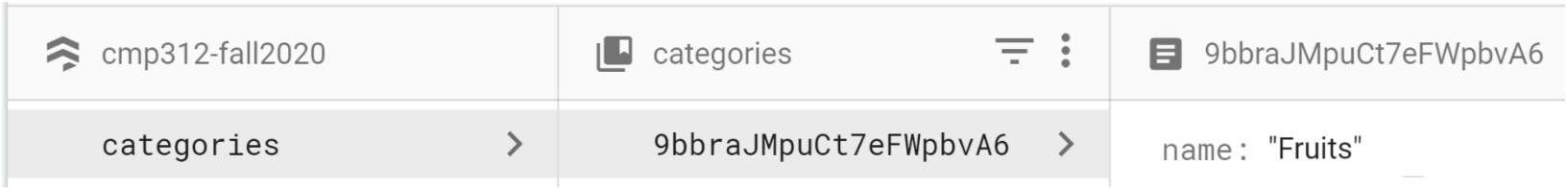
```
suspend fun getCategory(categoryName: String) : Category? {
    val queryResult = categoryCollectionRef.whereEqualTo("name", categoryName)
                                           .get().await()
    return queryResult.firstOrNull()?.toObject(Category::class.java)
}
```

Add a document to a Collection

- Get a collection reference

```
val collectionRef = Firebase.firestore.collection("colName")
```

- Call **`.add`** method and pass the object to add the collection
  - Firebase adds the object to the collection and returns the auto-assigned **`docId`**



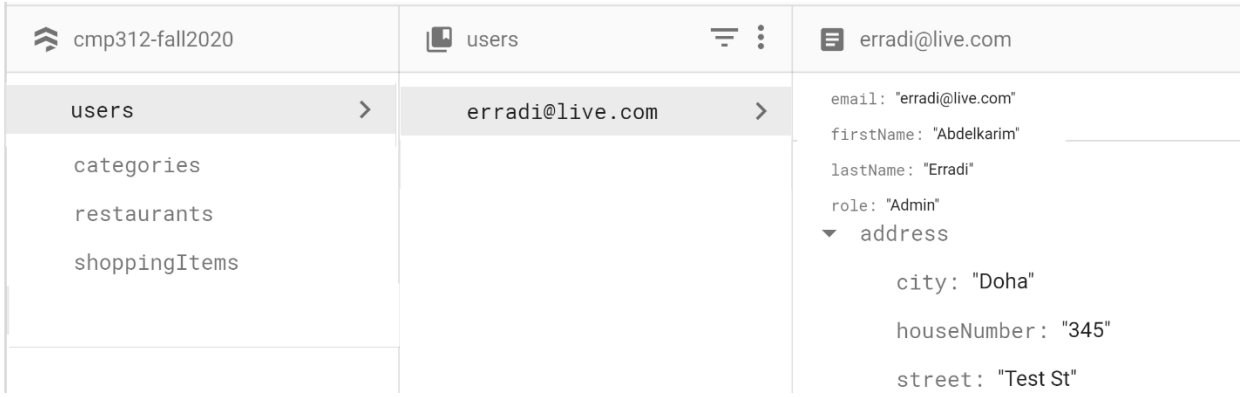

```
val category = Category("Fruits")
val categoryCollectionRef = Firebase.firestore.collection("categories")
val queryResult = categoryCollectionRef.add(category).await()
val categoryId = queryResult.id
```

Add a document and set DocId

- First specify the desired **docId** to be assigned to the new doc

  `collectionRef.document(docId)`

- Call **.set** method and pass the object to add the collection
  - Firebase adds the object to the collection and the id of the new doc is **docId** passed to **.document** method




```
suspend fun addUser(user: User) {
    val userCollectionRef = Firebase.firestore.collection("users")
    userCollectionRef.document(user.email).set(user).await()
}
```

Update a document

- Use **`.update`** and pass the fields to update and their new values
  - You can pass them as a Map

```
suspend fun updateQuantity(itemId: String, quantity: Int) {
    shoppingItemCollectionRef.document(itemId)
                             .update("quantity", quantity).await()
}
```

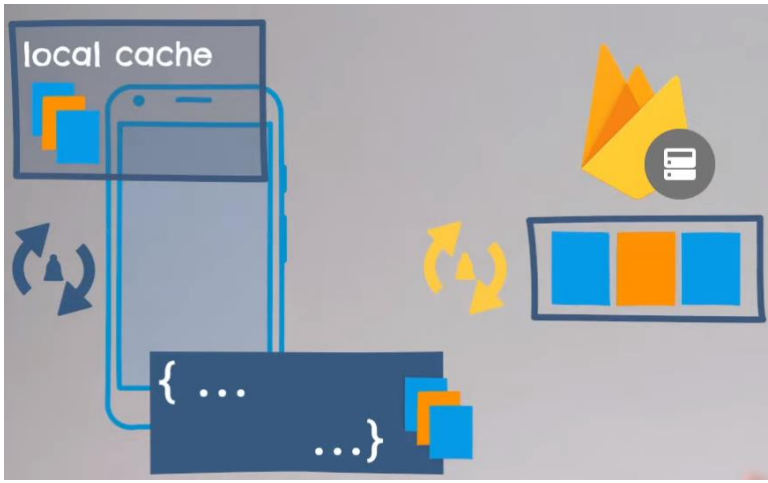
Delete a document

- Use **`.delete`** method to delete a document

```
suspend fun deleteItem(item: ShoppingItem) {
    shoppingItemCollectionRef.document(item.id).delete().await()
}
```

Subscribing to collection/document Realtime Updates

- Use **`.addSnapshotListener`** to observe the changes of a collection/document and get near **real-time updates**




```
private val _shoppingList = MutableLiveData<List<ShoppingItem?>>()
fun getShoppingListItems() {
    val query = shoppingItemCollectionRef.whereEqualTo("uid", uid)
    query.addSnapshotListener { snapshot, e ->
        if (e != null) {
            println("Shopping List Update Listener failed. ${e.message}")
            return@addSnapshotListener
        }
        _shoppingList.value = snapshot?.toObjects(ShoppingItem::class.java)
    }
}
```

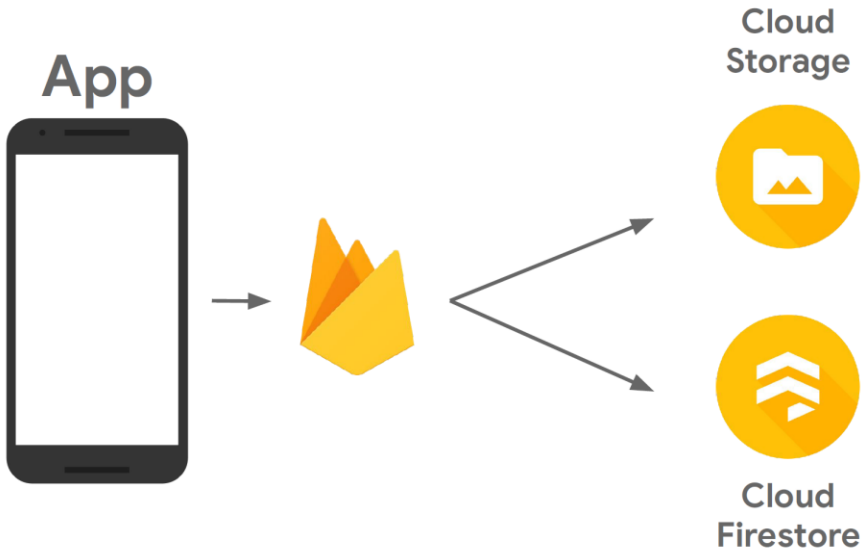
Watch: https://www.youtube.com/watch?v=3aoxOtMM2rc

Securing Data

- Cloud Firestore **Security Rules** consist of:
  - **match statements**, which identify documents in the database, and
  - **allow expressions**, which control access to those documents

```
// Allow read/write access on all documents to any user signed in to the app
service cloud.firestore {
  match /databases/{database}/documents {
    match /{document=**} {
      allow read, write: if request.auth.uid != null;
    }
  }
}
```

Firebase Cloud Storage



Firebase Cloud Storage

- Firebase Cloud Storage
  - Store and serve files
  - Robust
  - Secure
  - Access controlled with security rules

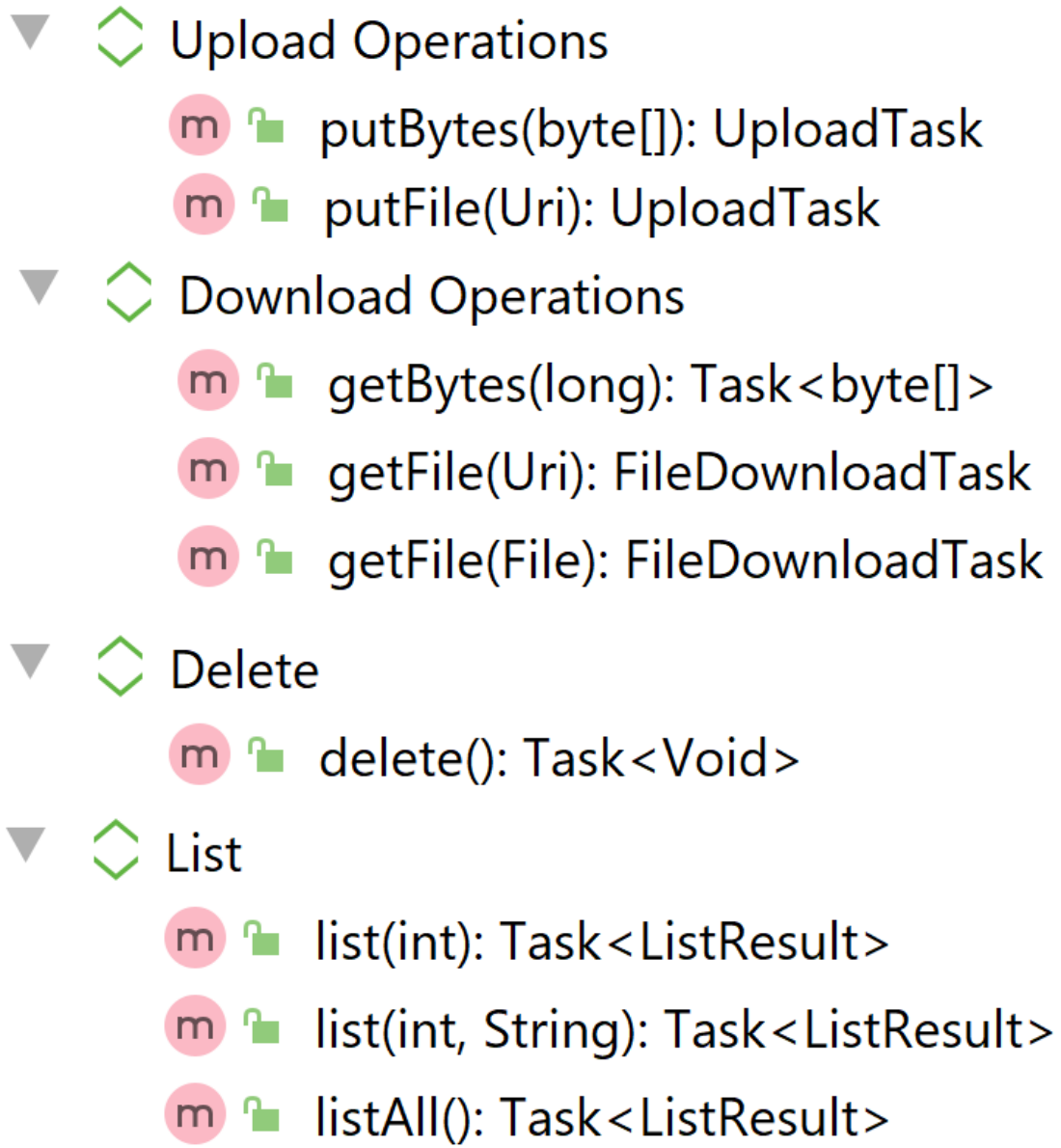
- Dependency

```
implementation 'com.google.firebase:firebase-storage-ktx:19.2.0'
```

- Firebase Cloud Storage reference

```
val storageRef = Firebase.storage.reference
```

Cloud Storage File Operations



List

- List files in particular subfolder

```
val images = storageRef.child("images/").listAll().await()
val imageUrls = mutableListOf<String>()
for(image in images.items) {
    val url = image.downloadUrl.await()
    imageUrls.add(url.toString())
}
```

Add

```
storageRef.child("images/$filename")
          .putFile(filePath).await()
```

Delete

```
storageRef.child("images/$filename").delete().await()
```

Download

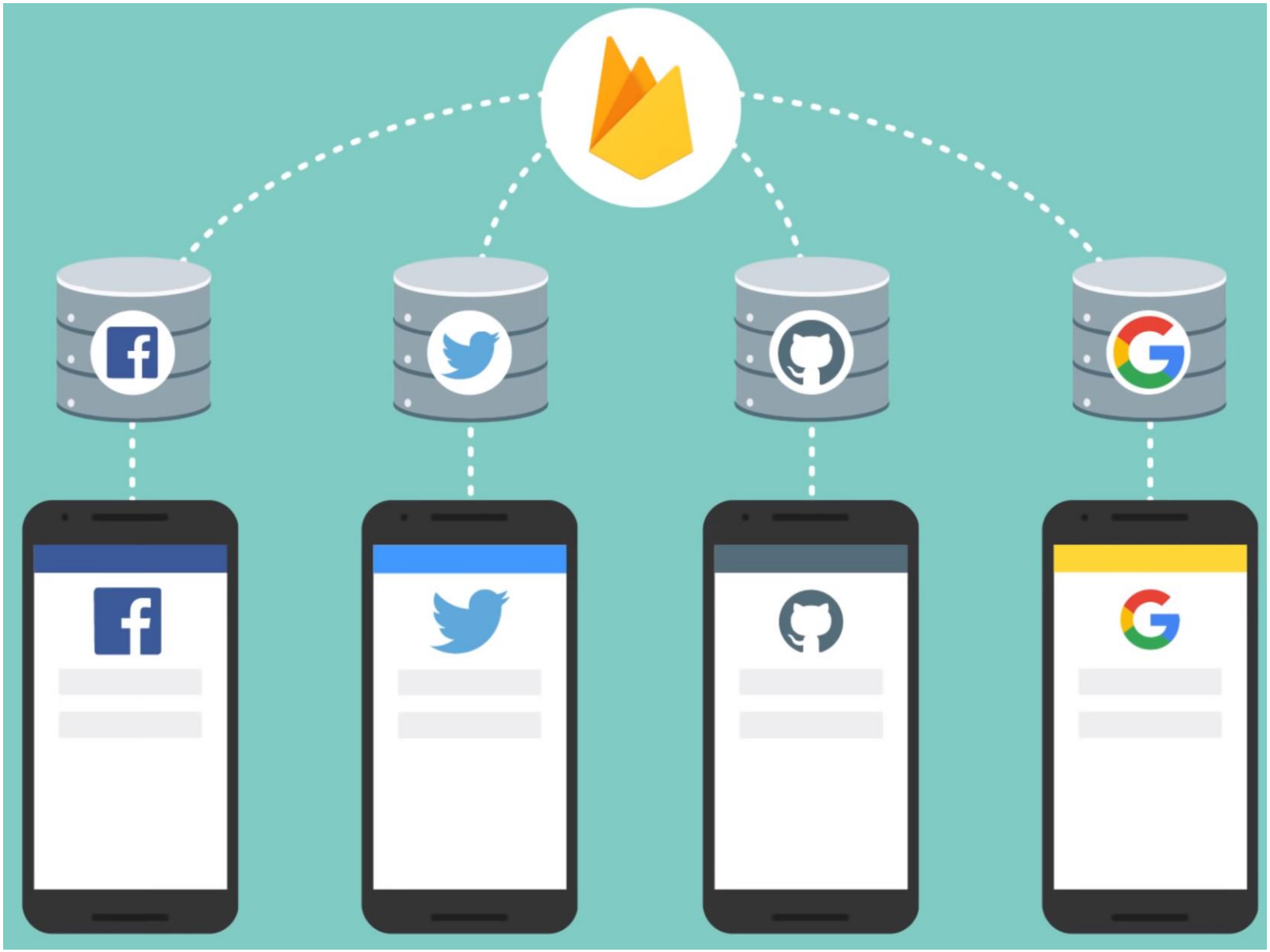
```
val maxDownloadSize = 5L * 1024 * 1024
val bytes = storageRef.child("images/$filename").getBytes(maxDownloadSize).await()
val bmp = BitmapFactory.decodeByteArray(bytes, 0, bytes.size)
withContext(Dispatchers.Main) {
    ivImage.setImageBitmap(bmp)
}
```

Firebase Authentication

Firebase Authentication

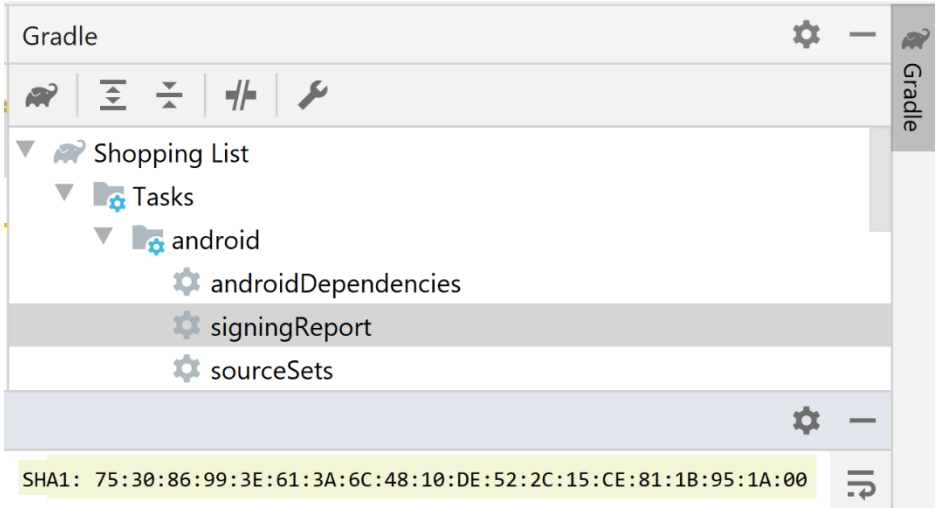
- **Authentication** = **Identity verification**:
  - Verify the identity of the user given the credentials received
  - Making sure the user is who he claims to be
- Every user gets a unique ID
- Restrict who can read and write what data

Multiple Identity Providers can be used for Authentication

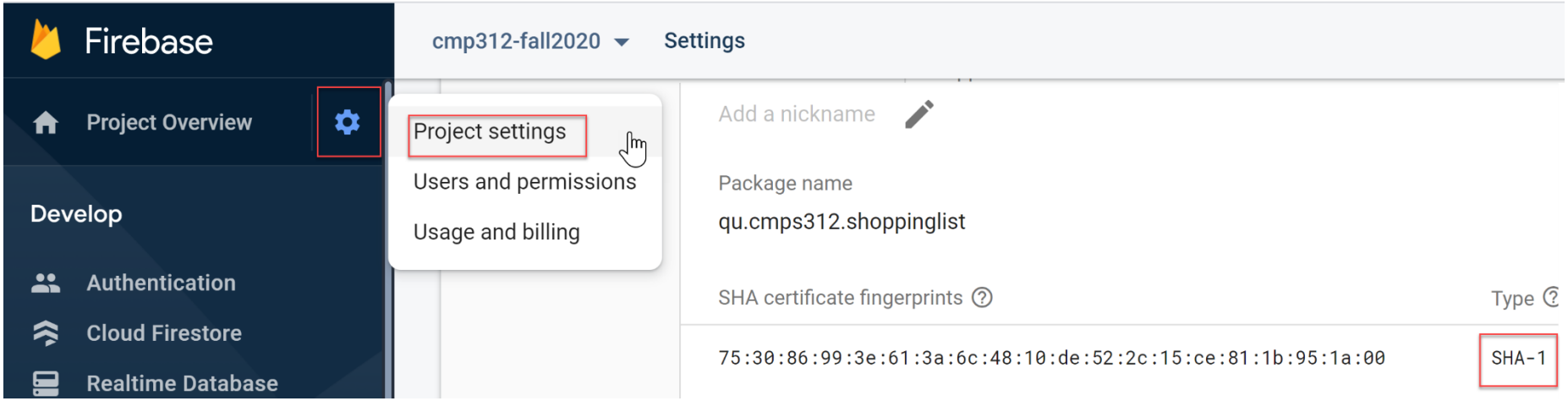


Configure Firebase Auth to use Google Auth

- Select Gradle in android studio from right panel
  - Double-click Tasks -> android-> **signingReport**



- Copy the generated SHA-1 to your Android app settings on Firebase console



Sign in

- Sign in using Firebase authentication

```
val authResult = Firebase.auth.signInWithEmailAndPassword(email, password).await()
println(">> Debug: signIn.authResult : ${authResult.user?.uid}")
```

Sign up

- Sign up and the user details to Firebase authentication

```
suspend fun signUp(user: User) : User? = withContext(Dispatchers.IO) {
    val authResult = Firebase.auth
          .createUserWithEmailAndPassword(user.email, user.password).await()

    authResult?.user?.let {
        val userProfileChangeRequest = userProfileChangeRequest {
            displayName = "${user.firstName} ${user.lastName}"
            photoUri = Uri.parse("http://test.com/spongebob.png")
        }
        // Add displayName and photoUri to the user
        // Unfortunately it does not allow adding custom attribute such as role
        it.updateProfile(userProfileChangeRequest).await()
}
```

Sign out

- Sign out from Firebase auth

```
Firebase.auth.signOut()
```

- Anywhere in the app you can access the details of current user

```
Firebase.auth.currentUser
```

- Observe authentication state change

```
Firebase.auth.addAuthStateListener {
    println("${it.currentUser?.email}")
}
```

Summary

- **Cloud Firestore** database store/query app's data
  - Data model consists of collections to store documents that contain data as a key-value pair similar to JSON
- Firebase **Cloud Storage** is used to store and retrieve files
- **Firebase Authentication** provides built-in backend services to ease user authentication
  - email/password authentication allows users to register and log in to the app
  - Secure user's authentication using various identity provides (e.g., email/password, Google Auth)

Resources

- Cloud Firestore
  - https://firebase.google.com/docs/firestore/
- Get to know Cloud Firestore
  - https://www.youtube.com/playlist?list=PLl-K7zZEsYLluG5MCVEzXAQ7ACZBCuZgZ
- Firestore codelab
  - https://codelabs.developers.google.com/codelabs/firestore-android
- Firebase Auth
  - https://firebase.google.com/docs/auth/android/start